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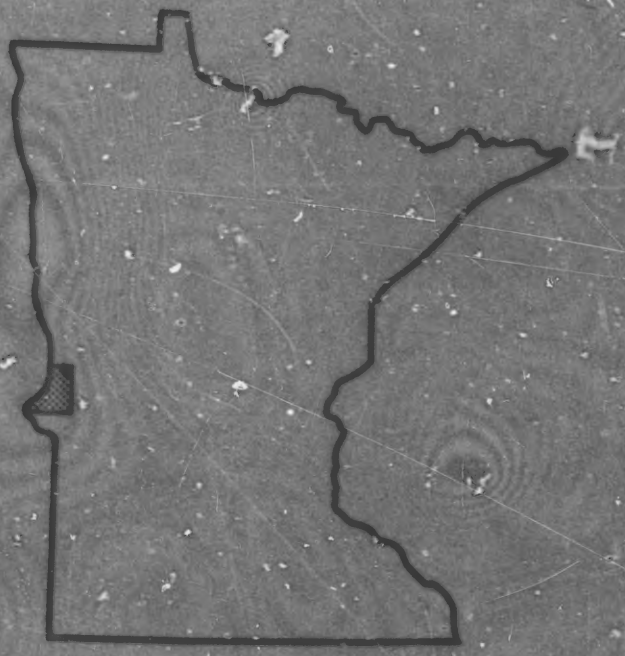
FLOOD INSURANCE STUDY

ORIGINAL

CITY OF TINTAH, MINNESOTA

TRAVERSE COUNTY



AUGUST 19, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 270482

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EXHIBITS

Flood Profiles

Judicial Ditch No. 12 Panel 01P

Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map

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FLOOD INSURANCE STUDY

CITY OF TINTAH,
TRAVERSE COUNTY,
MINNESOTA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Tintah, Traverse County, Minnesota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), St. Paul District (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1. This study was completed in March 1985.

1.3 Coordination

Streams requiring detailed study were identified during a telephone conversation between representatives of the FEMA Region V Office in Chicago, Illinois, and the Study Contractor.

On September 25, 1985, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Tintah, Traverse County, Minnesota. The area of study is shown on the Vicinity Map (Figure 1).

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FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TINTAH, MN

(TRAVERSE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

Flooding caused by overflow of Judicial Ditch No. 12 within the community was studied in detail.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through March 1990. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Tintah.

2.2 Community Description

The City of Tintah is located in the extreme northeastern portion of Traverse County in west-central Minnesota. Tintah is completely surrounded by the unincorporated areas of Traverse County. The city is situated approximately 115 miles northwest of the City of St. Cloud, Minnesota, approximately 65 miles southeast of the City of Moorhead, Minnesota, and about 130 miles northeast of the City of Watertown, South Dakota. The 1980 population was reported to be 119 (Reference 1).

The rich soils in the area support an extensive agricultural related economy. Development in the flood plain areas consists of a large number of residential structures and a few commercial structures.

The climate in the area varies from an average summer temperature of 70 degrees Fahrenheit (F.) to an average winter temperature of 12 degrees F. Extreme temperatures of 111 degrees F. in summer and -40 degrees F. in winter have been recorded at the National Weather Service station at the City of Campbell, Minnesota. The average annual precipitation is 24 inches; about 75 percent of this occurs as rainfall during the frost-free months from April to September (Reference 2).

Judicial Ditch No. 12 is part of a system of interconnected ditches that drain portions of Traverse and Grant Counties in west-central Minnesota. The ditch system empties into the Rabbit River near Campbell, approximately 5.6 miles downstream of Tintah.

Most of the basin drained by Judicial Ditch No. 12 is a flat lowland plain that was previously the bed of the glacial Lake Agassiz. Natural drainage is poor because of the flat topography. Since 1894, numerous ditches have been constructed forming the present network of drainage ditches spaced approximately one mile apart.

The upstream portion of the basin drained by Judicial Ditch No. 12 is a rolling upland glacial plain. The topography of the city is relatively flat with elevations ranging from about 995 to 998 feet National Geodetic Vertical Datum of 1929 (NGVD).

When the glacial ice that covered the basin receded, it left behind a mantle of glacial drift from 100 to 200 feet in thickness. Beneath the drift is a layer of limestone bedrock underlain by archaen rocks such as granite, feldspar, quartzite, and mica schist. The glacial till deposited by Lake

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Agassiz ranges from clayey to silty deposits to sandy areas and some gravel deposits (Reference 3).

2.3 Principal Flood Problems

Past flooding on Judicial Ditch No. 12 within and near the Tintah corporate limits indicates that flooding may occur during any season of the year. However, periods of high flow in the basin usually occur in late March to early April as a result of snowmelt or snowmelt combined with rainfall. High flows also occur during the summer months following an intense rainfall. Since no gaging stations are located in the vicinity of the study, no historic flood data are available.

2.4 Flood Protection Measures

A small levee, created as a result of the deepening of Judicial Ditch No. 12, exists in the study area and may provide the community with some degree of protection against flooding. However, this levee will not project the community from rare events such as the 100-year flood. The criteria used to evaluate protection against the 100-year flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 100-year flood are not considered in the hydraulic analysis of the 100-year floodplain.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

Discharges for Judicial Ditch No. 12 were computed using the U.S. Soil Conservation Service (SCS) Hydrologic Computer Program TR-20 (Reference 4).

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This program uses physical characteristics of a watershed, such as area, slope, land use, and soil types, to develop peak discharges. Soil types and land use in the Judicial Ditch No. 12 basin were determined from the Grant County soil survey (Reference 3). Watershed areas and slopes were determined from U.S. Geological Survey (USGS) 7.5 minute series topographic maps (Reference 5).

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
JUDICIAL DITCH NO. 12 at downstream corporate limits	89	2,000	3,350	4,000	5,800

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the Judicial Ditch No. 12 overbank areas were obtained by photogrammetric methods from aerial photographs (Reference 6). The channel sections were obtained by field measurement using normal survey methods; bridges and road profiles were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map.

Roughness factors (Manning's "n") used in the hydraulic analyses are based on engineering judgment, aerial photographs, and field observations of the ditch and flood plain areas. The "n" values used ranged from 0.05 to 0.08 in the overbanks. An "n" value of 0.04 was used for the channel.

The water-surface elevations for the floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (Reference 7). The computations started at normal depth.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations shown on the profiles are, thus, considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

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All elevations are referenced to the NGVD. Elevation reference marks used in this study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the ditch studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:1200 and a contour interval of 1 foot (Reference 6).

For the streams studied by approximate methods, only the 100-year flood plain boundary was delineated using the Flood Hazard Boundary Map for the City of Tintah (Reference 8).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In Minnesota, however, flood plain encroachment is limited by Minnesota Regulations to that which would cause a 0.5-foot increase in flood heights above pre-floodway conditions at any point (Reference 9). Floodways having no more than a 0.5-foot surcharge were delineated for this study.

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Floodway encroachment limits at each cross section were computed on the basis of equal conveyance reduction from each side of the flood plain and then adjusted where possible to reflect existing development. The floodway selected was approved by the Minnesota Department of Natural Resources. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed and are presented in Table 2, Floodway Data.

As shown on the Flood Boundary and Floodway Map, the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and the 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway of Judicial Ditch No. 12 lie outside the corporate limits.

The area between the floodway and the 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

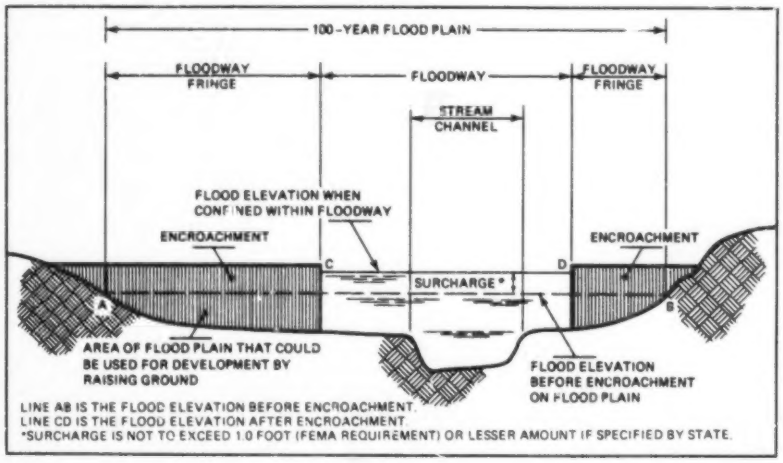
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Tintah.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
JUDICIAL DITCH 12								
A	1750	1107[2]	4219	0.9	998.1	998.1	998.4	0.3
B	2992	1500	4499	0.9	998.3	998.3	998.7	0.4
C	4053	950	3095	1.3	998.6	998.6	999.0	0.4
D	5130	800	3070	1.3	999.1	999.1	999.6	0.5
E	5390	950	3244	1.2	999.6	999.6	1000.1	0.5
F	6075	1100	3398	1.2	999.9	999.9	1000.4	0.5
G	6297	1145	3669	1.1	1000.0	1000.0	1000.5	0.5
H	7149	880	2742	1.5	1000.3	1000.3	1000.8	0.5
I	7369	880[3]	4163	1.0	1000.8	1000.8	1001.2	0.4
J	8092	1024[3]	4384	0.9	1000.9	1000.9	1001.3	0.4

[1]FEET ABOVE COUNTY BOUNDARY
[2]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS
[3]THIS WIDTH IS BEYOND CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TINTAH, MN

(TRAVERSE CO.)

FLOODWAY DATA

8

JUDICIAL DITCH NO.12

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the weighted average difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of the City of Tintah are shown on the Flood Profiles and are summarized in Table 3, Flood Insurance Zone Data.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a riverine reach is the weighted average difference between the 10- and 100-year flood water-surface elevations rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code. For example, if the difference between elevations is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.

Zone A2: Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations shown, and zones subdivided according to FHFs.

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Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- and 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and, areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are shown in Table 3, Flood Insurance Zone Data.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Tintah is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines for riverine flooding sources show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the City of Tintah (Reference 8).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 300 South Wacker Drive, Chicago, Illinois 60606.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
JUDICIAL DITCH NO. 12							
REACH 1	0001	−0.95	−0.26	0.60	010	A2	VARIES—SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TINTAH, MN

(TRAVERSE CO.)

FLOOD INSURANCE ZONE DATA

JUDICIAL DITCH NO. 12

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8.0 REFERENCES AND BIBLIOGRAPHY

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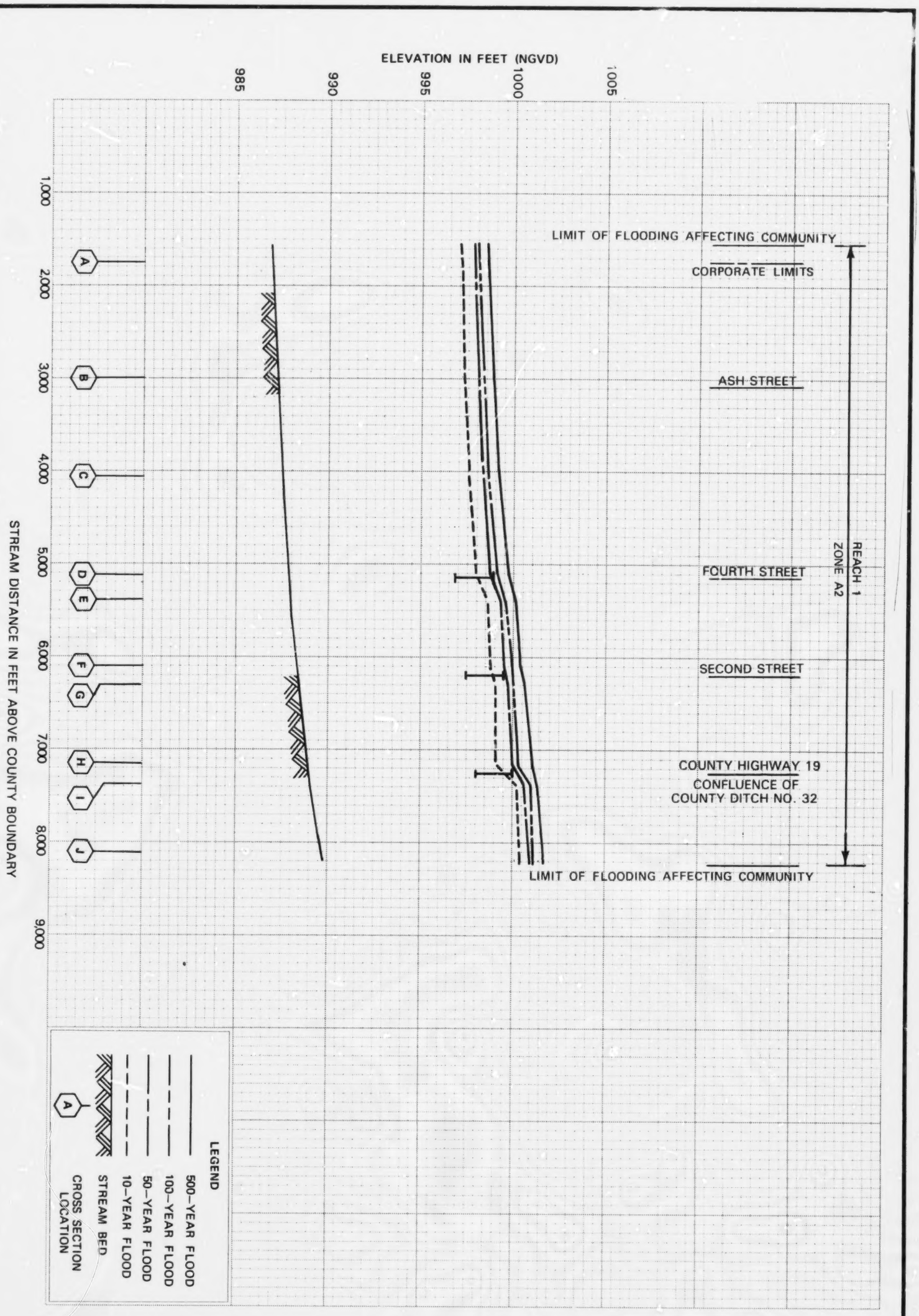

01P	FEDERAL EMERGENCY MANAGEMENT AGENCY **CITY OF TINTAH, MN** (TRAVERSE CO.)	**FLOOD PROFILES** **JUDICIAL DITCH NO. 12**

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